"…water quality issues …"

- **Intersect multiple beneficial uses,**
- **large scale, persistent, difficult;**
- **cross jurisdictional lines;**
- **multiple contributing factors;**
- **raise contradictions among CALFED goals;**
- **not amenable to single agency solutions;**
- **current and historical origins**

Delta Water Quality issues summary &

State of the Science: Water quality

The trend towards increased urbanization of the Central Valley and Delta continues and pollutants continue to be a problem in urban runoff.

Increased demand for water within the Delta watershed will also tend to reduce stream flow and exacerbate water quality problems.

Delta Visions Technical Summary

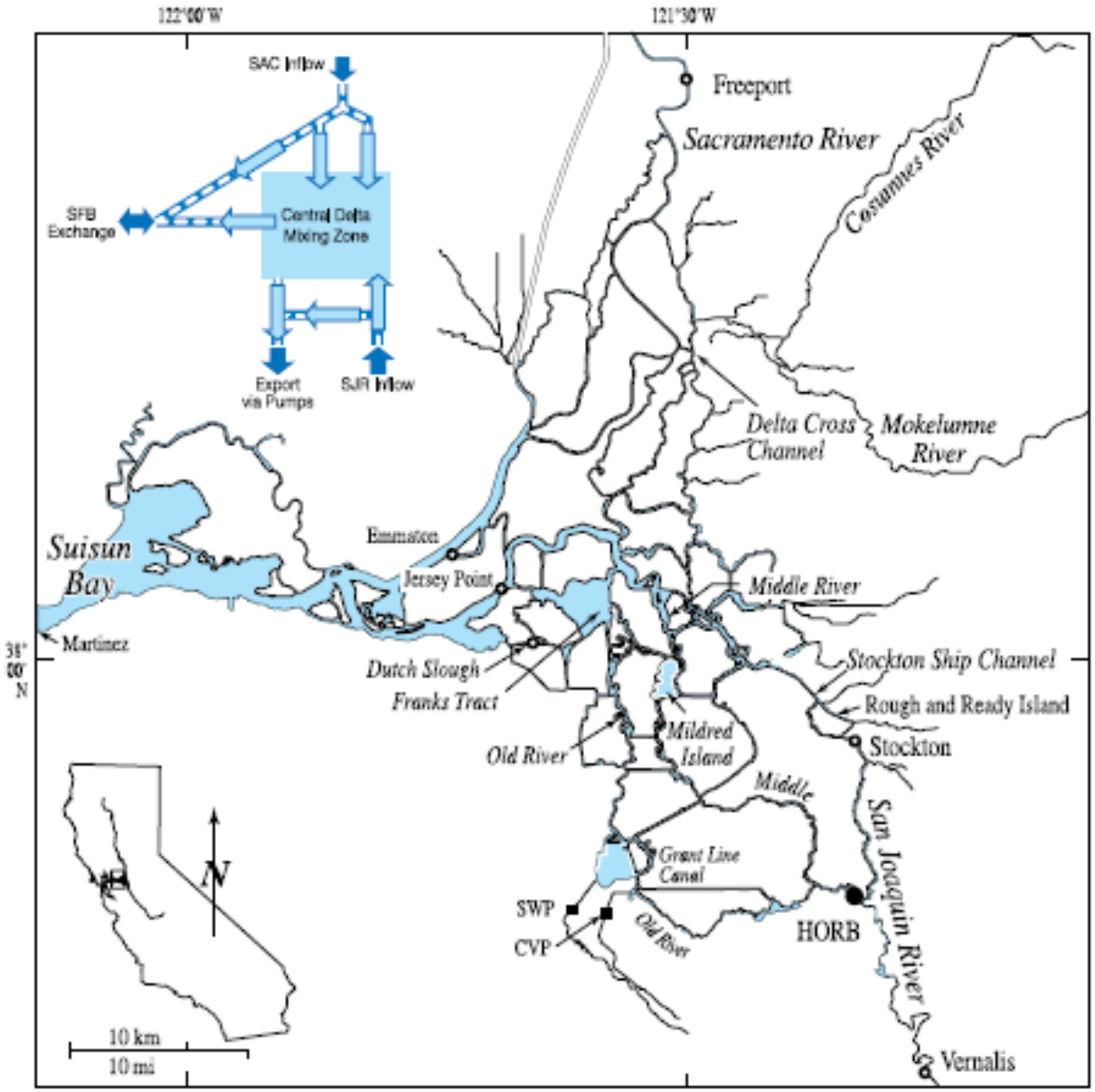
Highest priority water quality issues

- Salinity
- Drinking water quality,
- Dissolved Oxygen,
- Pesticides,
- Selenium,
- Mercury,
- Toxicity of Unknown Origin,
- *Endocrine disrupters & other emerging issues*

Salinity

A Delta that is heterogeneous and variable across space and time is more likely to support native species than is a homogeneously fresh or brackish Delta.

Lund et al 2007



Monsen et al 2007

Figure 2. Map of the Sacramento-San Joaquin Delta. Inset: Schematic illustrating the base flow routes through the Delta.

Changes to through Delta conveyance, such as installation of an operable barrier in a single west Delta channel (Franks Tract Project) or changing the way the Delta Cross Channel is operated, could reduce salinity and bromide at the south Delta pumps. *(Delta Vision Technical summary)*

Effects of changing operations &/or infrastructure

Monsen, Cloern and Burau, 2007, *SFEWS*

- *Transport routes change*
- *Source mixtures change*
- *Flushing times change*

Flushing times

- Oct 2001 Pumping curtailment (Monsen et al 2007)
  - Net southerly flow in Mildred's Island halved
  - Exchange rate between Mildred's and channel slowed considerably or reversed
  - Flushing of Stockton ship channel changed from days to weeks

Monsen et al 2007

Table 1. Water quality comparison between the Sacramento River, San Joaquin River, and In-Delta Agricultural Return water for water years 1999-2001.

Water Quality Parameter	Sacramento at Freeport [1]	San Joaquin at Vernalis	In-Delta Agricultural Return Water [2]
Specific Conductance	144 ± 28	621 ± 183	562 ± 206
Alkalinity (mg $CaCO_3$ L^{-1})	55 ± 12	85 ± 24	83 ± 18
Nitrite+Nitrate (mg N L^{-1})	0.12 ± 0.05	1.62 ± 0.59	
Dissolved Organic Carbon (mg C L^{-1})	1.84 ± 0.53	2.83 ± 0.47	14.1 ± 7.7
Total Dissolved Selenium[3]	0.07 ng/l	0.6 – 6 ng/L	Negligible[4]

“If the major water projects ultimately route water around the Delta, the remaining Delta water sources will have a proportionately increased influence on Delta water quality.”

Delta visions

Reduction of export pumping decreases the proportion of Sacramento River water in the central Delta…Monsen et al 2007

Changing Delta conveyance may reduce or eliminate the “incidental benefit” of current through-Delta conveyance, whereby high quality water moving through the central Delta dilutes many tributary and in-Delta sources of pollutants. Delta visions

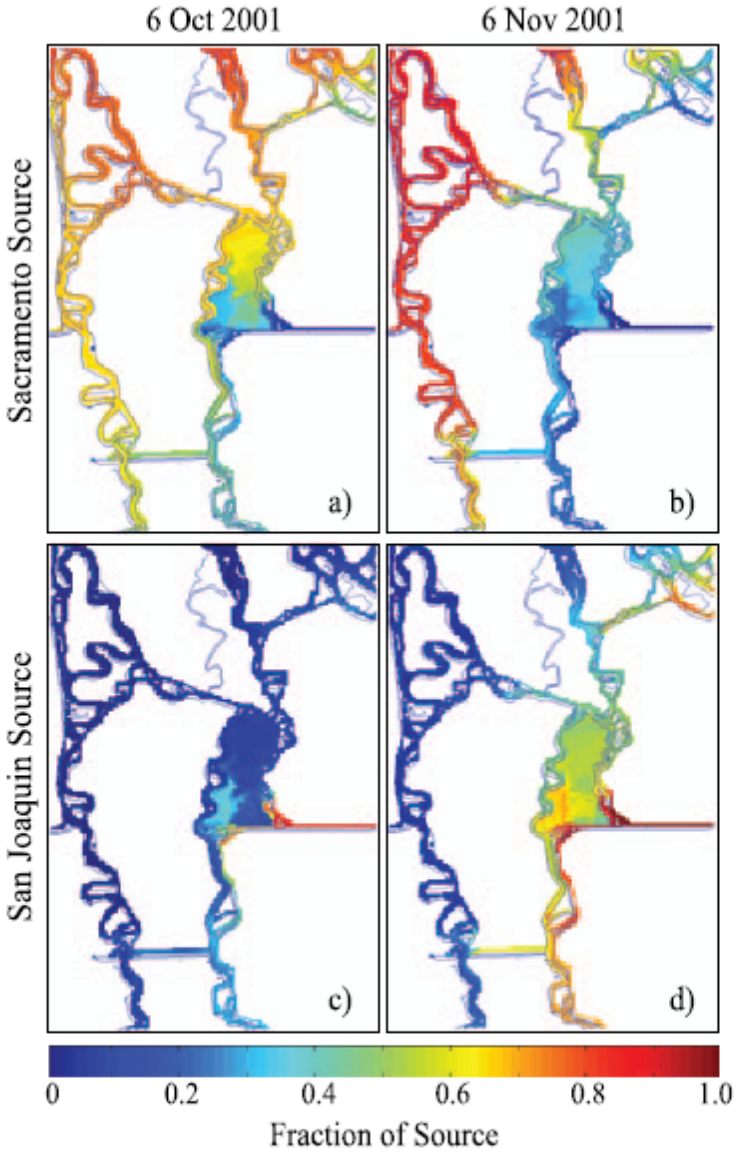


Figure 5. Model-computed fractions of Sacramento (a, b) and San Joaquin River (c, d) source water at each grid cell around Mildred Island on 6 October 2001 (a, c), immediately prior to reduced pump operations, and on 6 November 2001 (b, d) after a month of pump curtailment.

Mercury has known effects on contamination of the human food chain and environmental justice.

Effects on species less certain; Evidence it impedes recovery of clapper rail in South Bay…(Schwartzbach et al 2006)

•Loss of habitat is the first order cause of the decline (90% of suitable marsh lost)

•Elimination of other stressors is essential to preserving the remnant populations

• Reproductive potential of the clapper rail was found to be 'much reduced over natural potential' (7 eggs/nest yield 1.9 – 2.5 chicks, after predation).

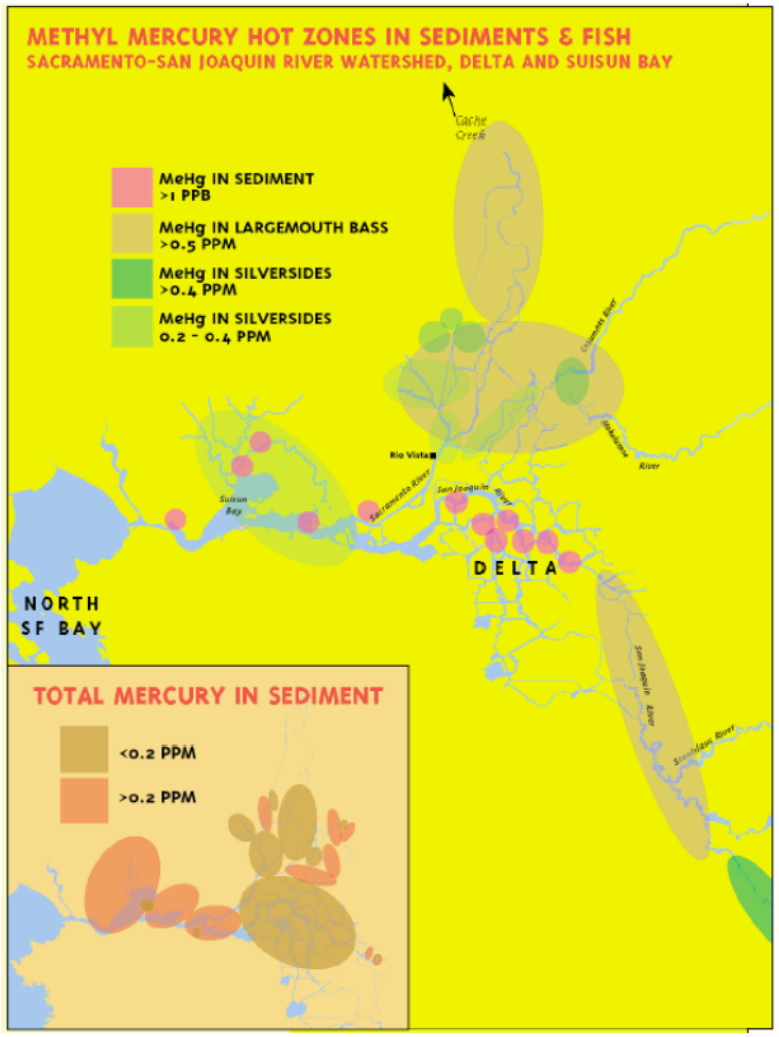
•histopathology typical of chemical contamination; Other chemicals eliminated as causes;

• Hg = 0.5 – 12.9 μg/g dw; 50% of eggs > 2.5 μg/g dw

Mercury monitoring is essential. (Delta Vision)

Mercury

UC Davis



Although mercury is found at levels of concern throughout the Bay-Delta system monitoring of sport fish (Largemouth Bass) and prey species (Silversides) indicate that methylmercury production is highest in Delta tributaries. (CALFED Science Program 2005)

Mercury

Stewart et al, in review

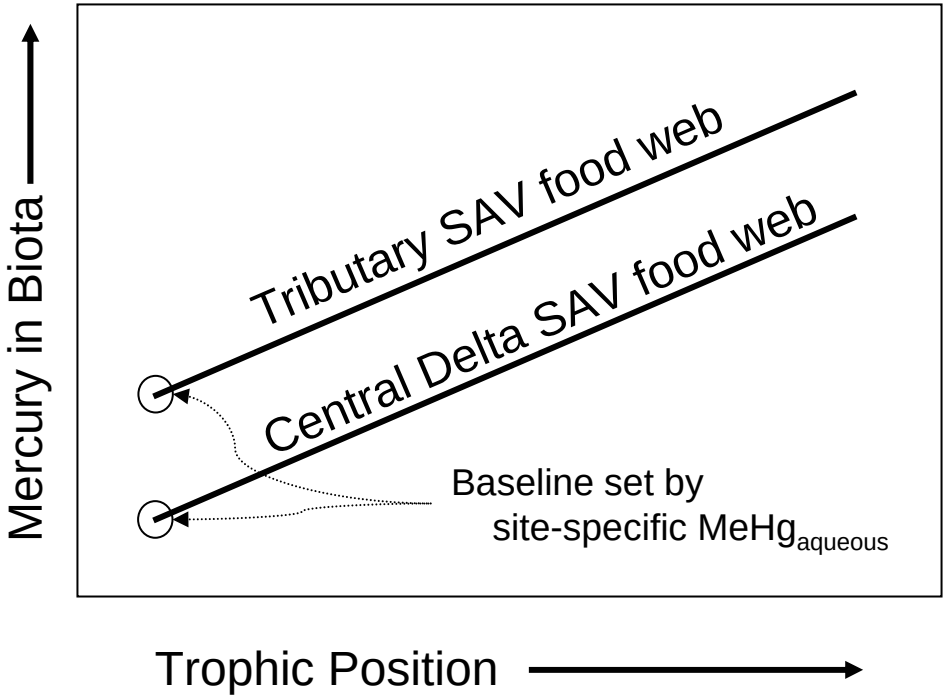
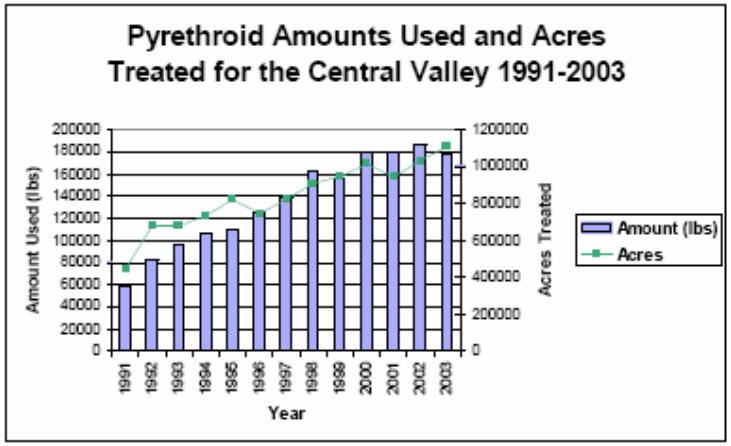
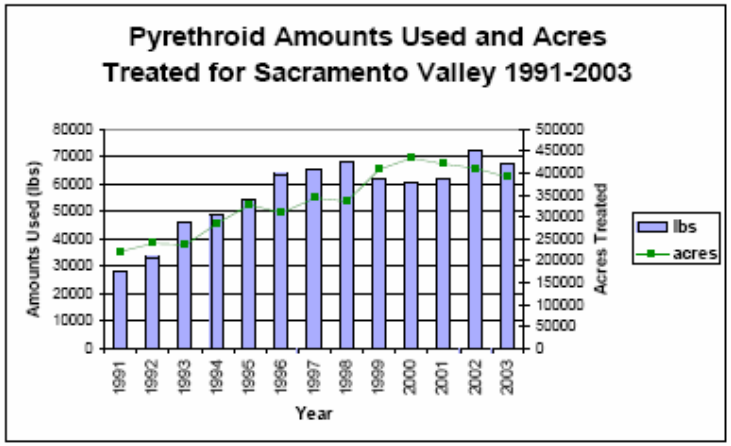
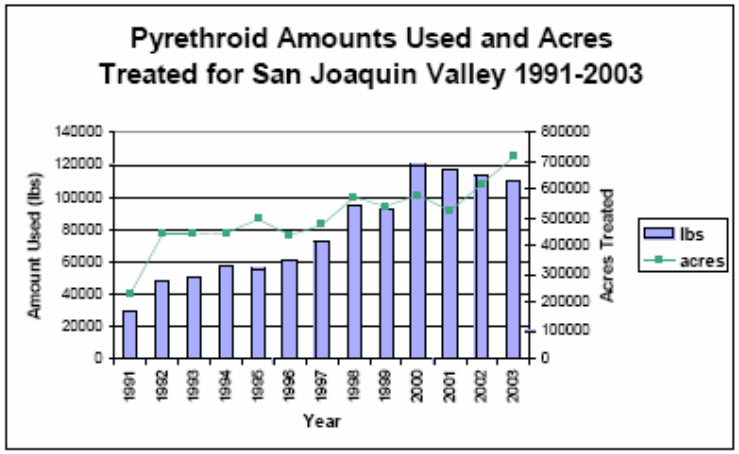


Figure 1. Schematic showing similar patterns of increasing mercury concentrations in biota with increasing trophic position (biomagnification) in submerged aquatic vegetation (SAV) food webs in the tributaries and central delta. Relative differences observed among biota at any trophic level among different locations appear to be determined at the base of the food web and are correlated with site-specific aqueous MeHg concentrations.

Pesticides and toxicity are still regularly observed and long term effects of low level pesticide exposures are not fully understood.
(Delta Visions technical summary)



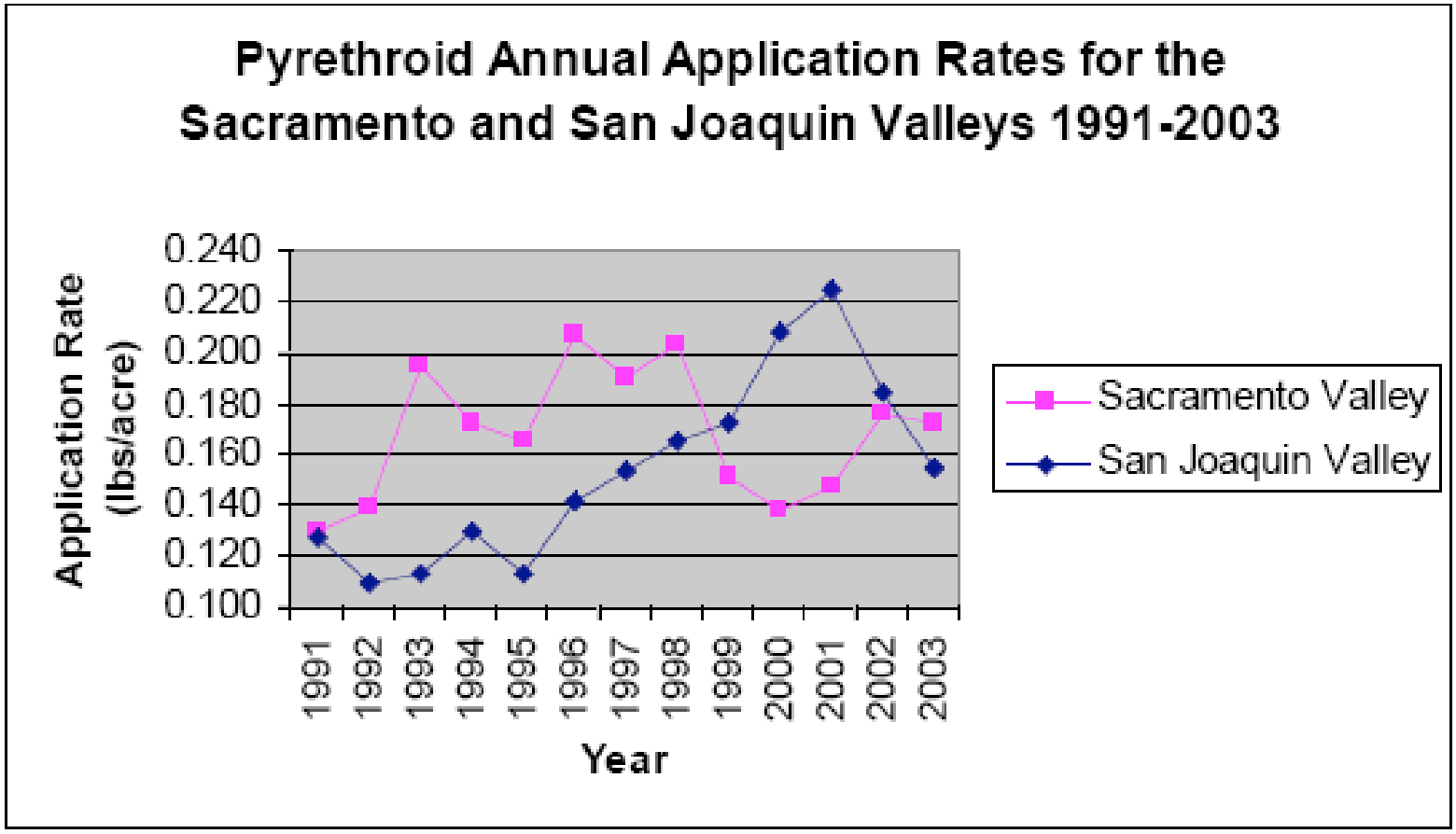




Oros and Werner,

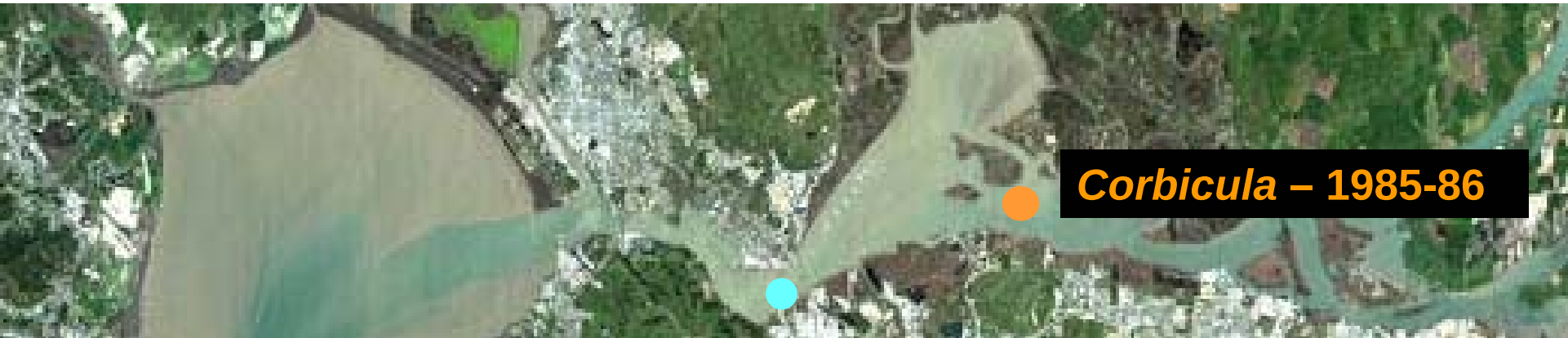
Pyrethroids (Weston et al 2004)

- **70 sediment samples** were collected over a 10-county area in the Central Valley
- **42% of the locations** with significant mortality to one test species
- **14%** of the sites (two creeks and four irrigation canals) showed **extreme toxicity** (>80% mortality) on at least one occasion.
- **Pyrethroids** detected **in 75%** of samples
- Pyrethroid concentrations high enough explain **40%** of toxicity to *C. tentans* and nearly **70%** of toxicity to *H. azteca*.

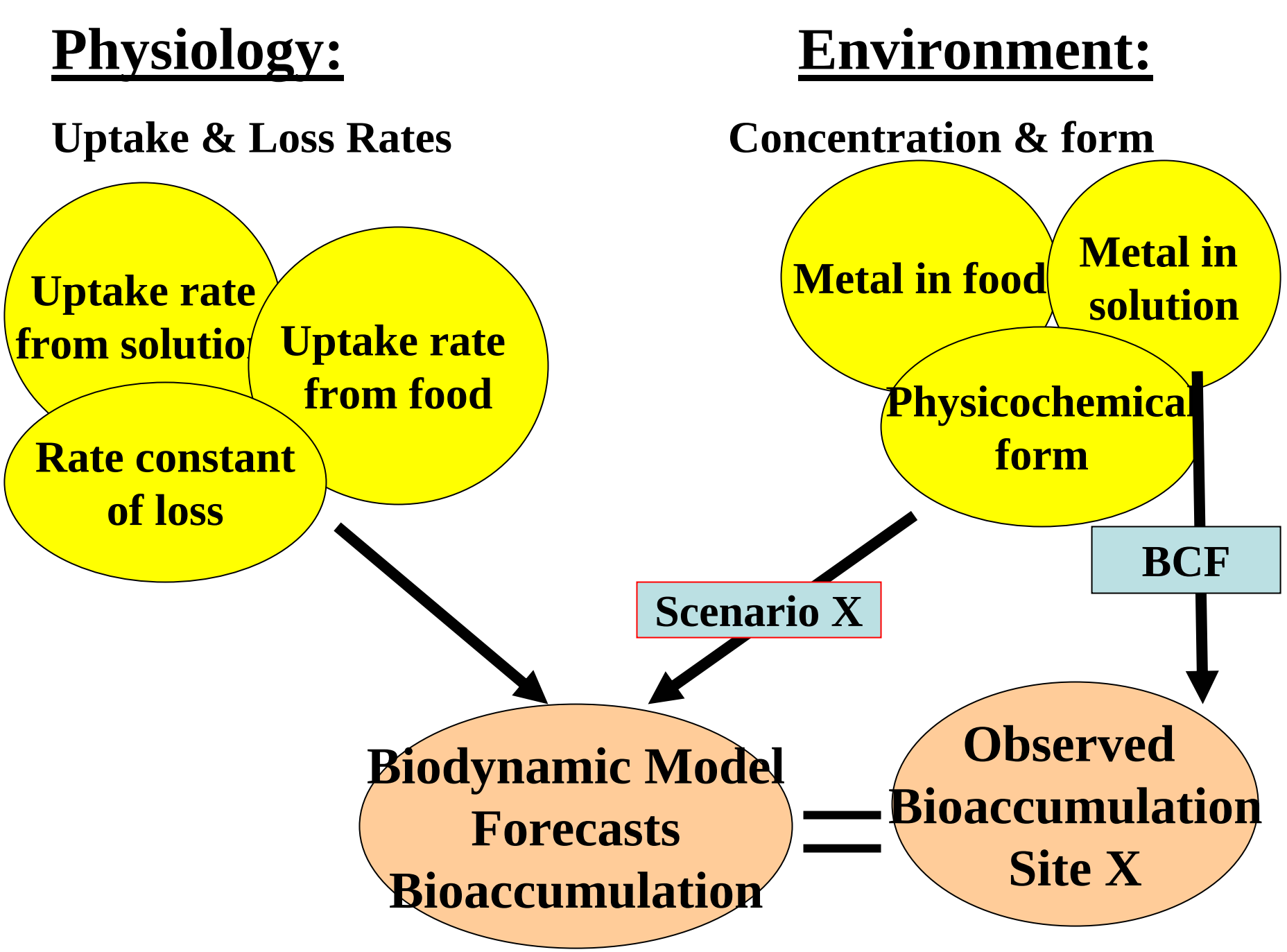


igure 7. Line plot showing pyrethroid annual application rates for the Sacramento and San oaquin Valleys 1991-2003.

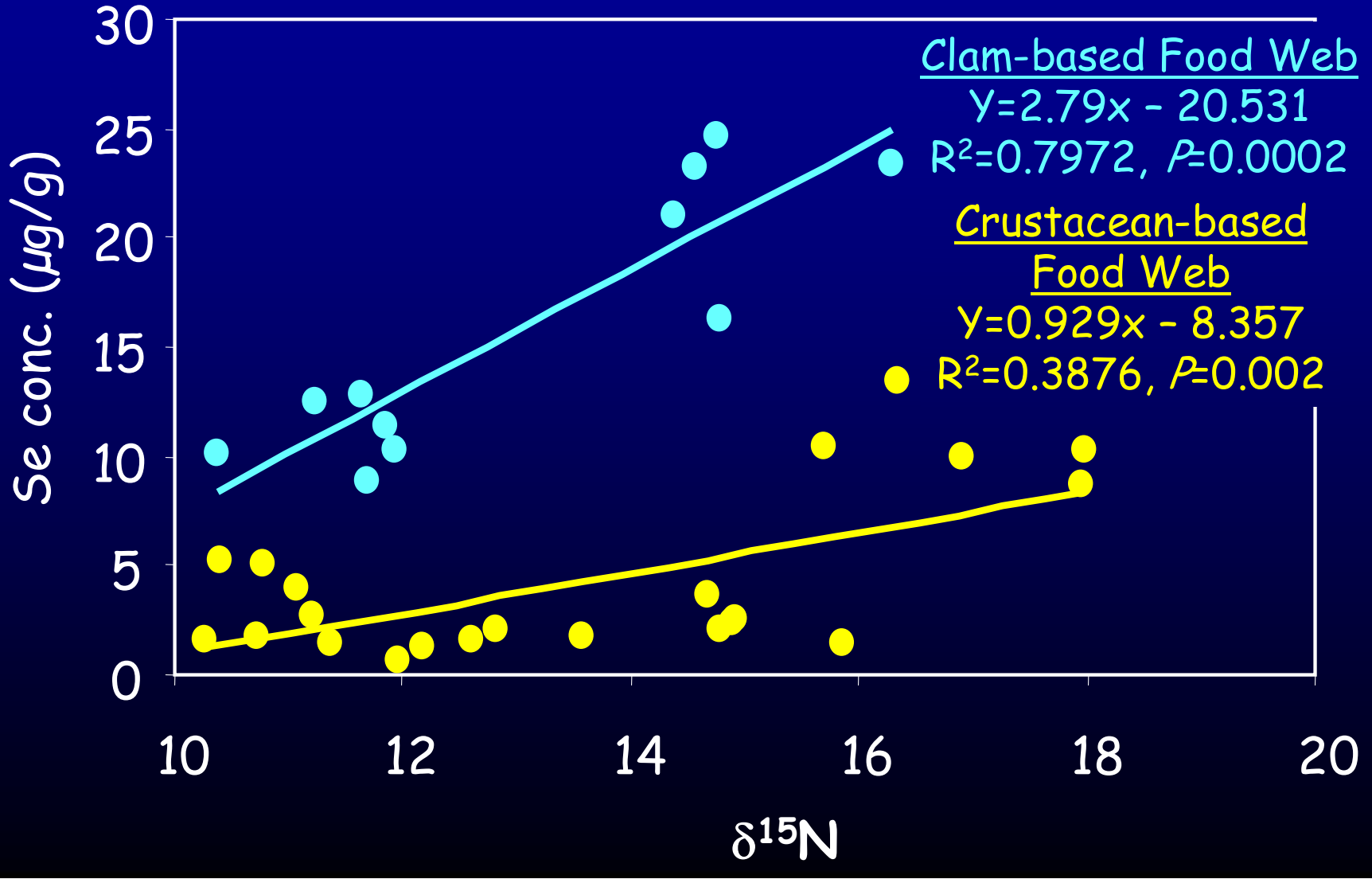
Oros and Werner


Corbicula – 1985-86

Corbula amurensis
Corbicula fluminea
1985-87
Se conc. (µg/g dry wt)
SJR/Delta Outflow
25
20
15
10
5
0
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Dec-94
Jun-95
Dec-95
Jun-96
Dec-96
Jun-97
Dec-97
Jun-98
Dec-98
Jun-99
Dec-99
Jun-00
Dec-00
Jun-01
Dec-01
Jun-02

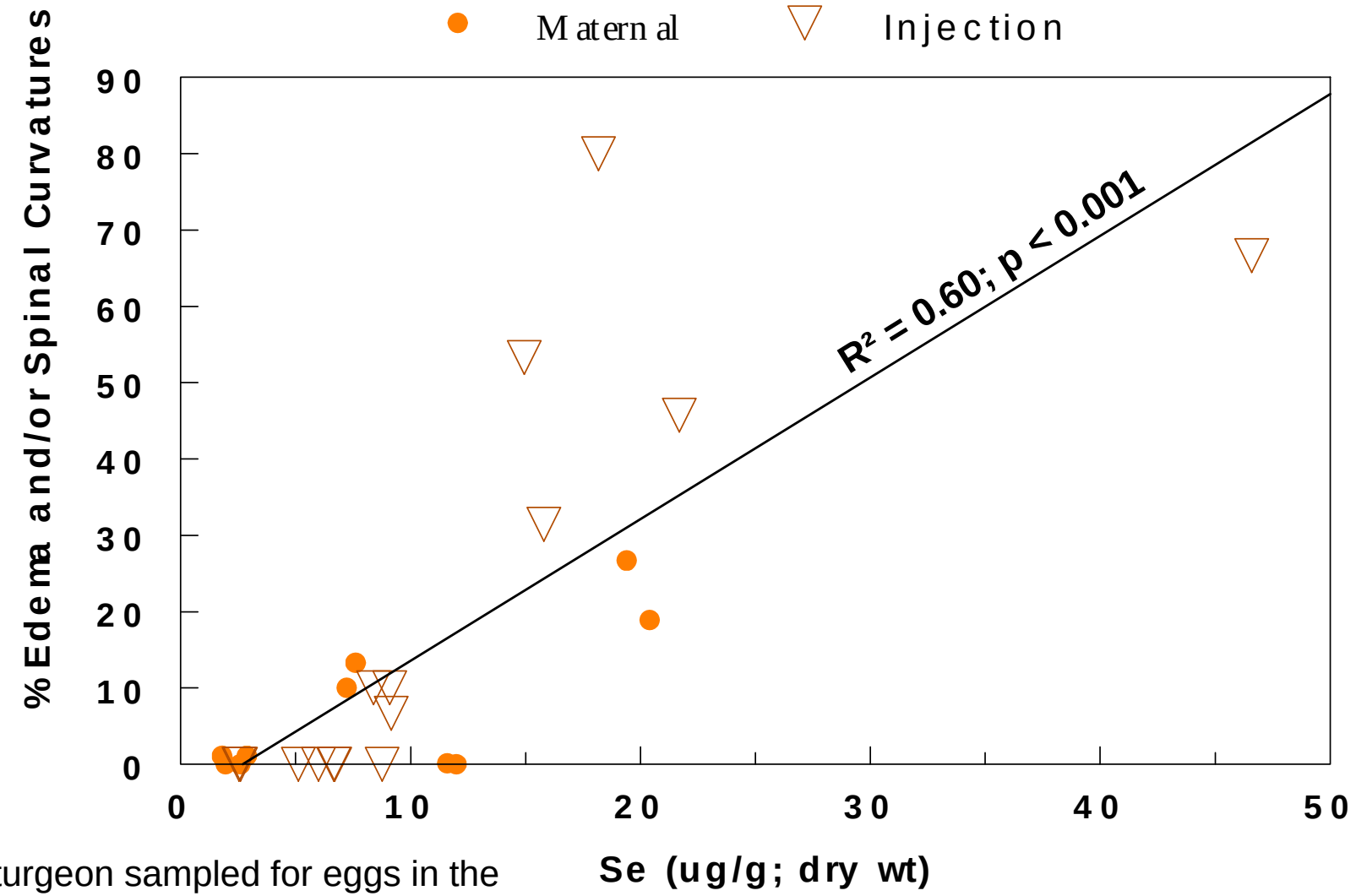

Physiology:
Environment:
Uptake & Loss Rates
Concentration & form
Uptake rate from solutio
Uptake rate from food
Rate constant of loss
Metal in food
Metal in solution
Physicochemical form
BCF
Scenario X
Biodynamic Model Forecasts Bioaccumulation
Observed Bioaccumulation Site X

Clam-based Food Web Has a Higher Se Biomagnification Potential than Crustacean Food Web



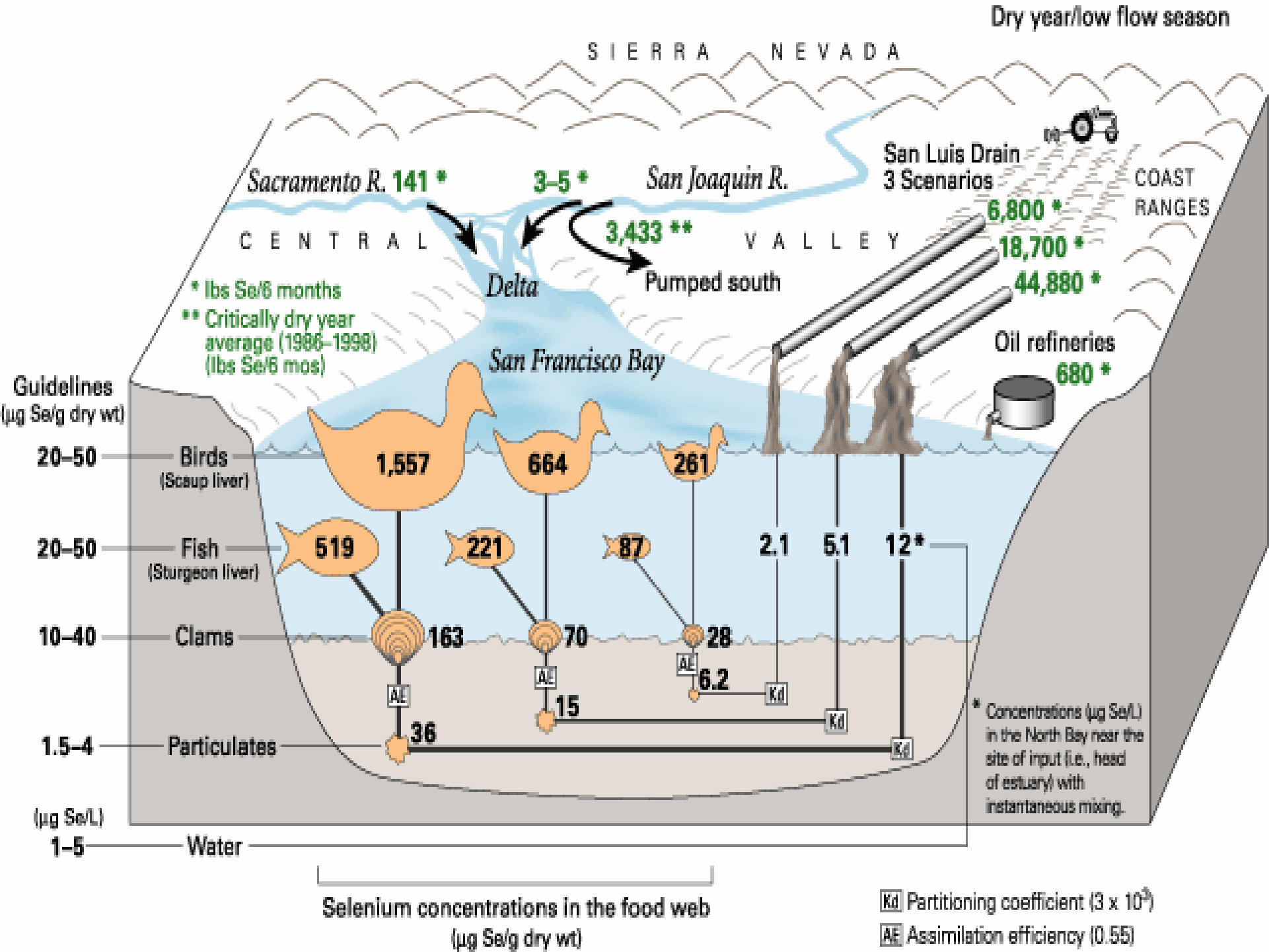
Effects of Selenium in White Sturgeon Larvae

Maternal and Injection Exposures Combined



Out of six sturgeon sampled for eggs in the 1990's, 4 had eggs ranging from 8 – 12 ppm Se and one had eggs with 29 ppm.

Linville 2007


Dry year/low flow season
SIERRA NEVADA
Sacramento R. 141 *
3–5 *
San Joaquin R.
CENTRAL VALLEY
3,433 **
Pumped south
Delta
San Luis Drain
3 Scenarios
6,800 *
18,700 *
44,880 *
COAST RANGES
* lbs Se/6 months
** Critically dry year average (1986–1998) (lbs Se/6 mos)
San Francisco Bay
Oil refineries
680 *
Guidelines (µg Se/g dry wt)
20–50 Birds (Scaup liver)
1,557
664
261
20–50 Fish (Sturgeon liver)
519
221
87
2.1
5.1
12*
10–40 Clams
163
70
28
AE
6.2
Kd
15
1.5–4 Particulates
36
* Concentrations (µg Se/L) in the North Bay near the site of input (i.e., head of estuary) with instantaneous mixing.
(µg Se/L)
1–5 Water
Selenium concentrations in the food web
(µg Se/g dry wt)
Kd Partitioning coefficient (3 x 10³)
AE Assimilation efficiency (0.55)

Conclusions

- An isolated facility will change water quality in the Delta and the Bay….evaluation of the nature and implications of those changes is essential
  - Short term: Modeling scenarios as part of decision process and engineering preparations.
  - Long-term: Study pesticides, Se, MeHg, salinity/habitat/ecology linkages, etc.
  - Coherent monitoring plan:
    - Se – *C. amurensis*
    - Hg – forage fish
    - Pesticides – pyrethroids
    - DO – monitor ship channel
    - Water sources/transport/residence time changes in key areas